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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

RUGGLES, JOHN S

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 03/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/894,230

Applicant(s)

KO ET AL.

Examiner

John Ruggles

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 13 August 2002 and 26 June 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-36 is/are pending in the application.
- 4a) Of the above claim(s) 1-15 and 25-36 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 16-24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☒ Claim(s) 1-36 are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 June 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Election/Restrictions*

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-15, drawn to an apparatus, classified in class 355, subclass 18.
- II. Claims 16-24, drawn to a process for hardening a developed photoresist and subsequent etching, classified in class 430, subclass 313.
- III. Claims 25-36, drawn to a process for curing a developed photoresist, classified in class 430, subclass 311.

Inventions of Groups II-III and I are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case the apparatus can be used to practice another and materially different process, such as coating.

Inventions of Groups II and III are unrelated. Inventions are unrelated if it can be shown that they are not disclosed as capable of use together and they have different modes of operation, different functions, or different effects (MPEP § 806.04, MPEP § 808.01). In the instant case the different inventions are not usable together and have different effects. Groups II and III are distinct inventions because Group II recites a process for hardening a developed photoresist and subsequent etching using the hardened photoresist while Group III recites a process of curing a developed photoresist, per se.

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Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Michael Glencarella on 30 January 2003 a provisional election was made without traverse to prosecute the invention of Group II, claims 16-24. Affirmation of this election must be made by applicant in replying to this Office action. Claims 1-15 and 25-36 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to non-elected inventions.

#### ***Information Disclosure Statement***

The information disclosure statement filed 13 August 2002 fails to comply with 37 CFR 1.98(a)(1), which requires a list of all patents, publications, or other information submitted for consideration by the Office. It has been placed in the application file along with corresponding US Patent Application Publication 2003/0003683 (cited on the attached PTO-892). The information referred to therein has been considered.

#### ***Drawings***

New corrected drawings are required in this application because the instant originally submitted drawings are hand-drawn and informal. Applicant is advised to employ the services of a competent patent draftsman outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action

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to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

The drawings are objected to because Figure 3 does not show substrate 122 found in the description of Figure 3 on page 11. Also, the description of Figure 5 found on page 12 appears to better correlate to either Figure 3 or 4. Further, to better correlate with the description on page 15, the wording of flowchart 154 in Figure 5 should be corrected as follows: (1) "photoresist" should be changed to --top photoresist-- in block 156 and (2) "first photoresist" should be changed to --top photoresist-- in blocks 158 and 160. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### *Specification*

The disclosure is objected to because of the following informalities: (1) on page 7, in the brief descriptions of Figures 2-5, "illustrates" should be changed to --illustrates a--; (2) on page 12, in the first line of the second paragraph, "Figure 5" should be corrected to the most appropriate figure number (e.g., --Figure 3--, --Figure 4--, etc.) which is best correlated to the description in this paragraph; (3) also on page 12, but in the first line of the third paragraph, the appropriate figure number should be inserted which is best correlated to the description in this paragraph (e.g., change "diagram 134" to --diagram 134 of Figure 3--, etc.).

Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 23 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Instant claim 23 requires controlling the chamber pressure between about 50mT and about 300mT, but this requirement is not supported by the specification. Instead, instant page 16 of the original specification describes controlling the chamber pressure between about 1 Torr and about 5 Torr with a preferred pressure of about 3 Torr. Therefore, the specific chamber pressure limitation of claim 23 is not enabled by the specification and may only be replaced (upon amendment) by the pressure range supported in the original specification on page 16 as discussed above.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 17 and 24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

While applicant may be his or her own lexicographer, a term in a claim may not be given a meaning repugnant to the usual meaning of that term. See *In re Hill*, 161 F.2d 367, 73 USPQ 482 (CCPA 1947). The term “acetyl” in claim 17 is used by the claim to mean “-CH<sub>3</sub>” as

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shown by the last line on instant page 11, while the accepted meaning is "CH<sub>3</sub>CO-" as shown on page 7 of Grant & Hackh's *Chemical Dictionary*, 5<sup>th</sup> Edition, published by McGraw-Hill in 1987.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 16-17 are rejected under 35 U.S.C. 102(e) as being anticipated by Sato (US Patent 6,337,163).

Sato teaches a process for improving etching resistance (increasing selectivity) of an organosilicon photoresist by first energy beam imaging of the photoresist with or without post-exposure baking, developing, then second energy beam post-treatment (exposing) of the imaged photoresist (column 97, lines 42-54). Column 5, lines 6-7 show alternative use of a charged beam (electron or ion beam specified at column 3, lines 59-61) as the first energy beam and ultraviolet (UV) rays as the second energy beam. The second energy beam (UV) exposure cross-links organosilicon polymer in the imaged photoresist to form a hardened etching mask having improved resistance to subsequent etching (column 82, lines 15-18 and column 96, lines 56-64). Specific examples of organosilicon compounds useful in the photoresist are polysilane and polysilene shown by formulas [1-1] to [1-114] in columns 6-28, but particular attention is drawn

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to those showing Si-H and Si-CH<sub>3</sub> bonds, such as those in formulas [1-14] to [1-16] found in column 8 (instant claim 17 interpreted only as disclosed in the last line of instant page 11).

Examples of cross-linking agents having multiple (double or triple) bonds are shown by formulas [3-1] to [3-88] in columns 61-72 and are described as reacting at Si-H bonds to cross-link the organosilicon polymer under the effect of heat or light at column 61, line 50 to column 62, line 51. Other examples of cross-linking agents are described at column 82, line 1 to column 96, line 55.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato as applied to claims 16-17 above, and further in view of Tsai, et al. (US Patent 5,899,748).

While showing UV exposure of a developed organosilicon photoresist image to cross-link and harden the photoresist layer followed by subsequent etching through the hardened photoresist layer, Sato does not specify that the UV exposure should be conducted in an etching chamber.

Tsai specifies UV exposure of a photoresist layer in an etching chamber that provides UV emission and implies the advantage of simplified processing over UV exposure and etching in



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separate chambers (which would require taking the photoresist layer off-line for UV treatment before returning the photoresist layer to the etching chamber described at column 6, lines 30-39).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to expose the photoresist to UV hardening as taught by Sato in an etching chamber that provides UV emission prior to etching with the expectation of simplifying processing (by avoiding taking the photoresist to a separate UV chamber before returning the photoresist to the etching chamber) as taught by Tsai.

Claims 19-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato in view of Tsai as applied to claim 18 above, further in view of Kishimura (US Patent 5,123,998), further in view of Singh, et al. (US Patent 6,479,820), and further in view of George, et al. (US Patent 4,980,563).

Sato and Tsai do not specify use of argon (Ar) inert gas flowing to the etching chamber at about 1000 to 3000 sccm during UV exposure generated by neon (Ne) gas and do not specify that the flow rate of Ne must be about 0.2% to 0.8% of the flow rate of Ar. Also, Sato and Tsai do not point out the pressure of the chamber during UV exposure.

Kishimura teaches UV imaging (exposing) of a photoresist in inert gas (e.g., Ne, Ar, He, N<sub>2</sub>, etc., column 10, lines 5-9) for more efficient cross-linking of the photoresist by the UV exposure (column 5, lines 58-68), selective silylation to incorporate silicon (Si) into the photoresist by forming Si-CH<sub>3</sub> bonds (shown in Figure 2B) with the unexposed areas of the photoresist (column 6, lines 21-25), followed by developing and dry etching by O<sub>2</sub> reactive ion etching (RIE) to convert the silylated regions of the photoresist to SiO<sub>2</sub> as a powerful shielding

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material to O<sub>2</sub> plasma, allowing only the exposed regions to be removed by etching (column 6, lines 26-31).

Singh describes plasma post-treatment of a developed photoresist image in which the plasma includes one or more inert gases (e.g., Ar, Ne, He, etc.) flowing at 10 sccm to 10 slm (10,000 sccm) under a pressure of 0.0001 to 1,000 Torr to ionize and maintain the inert gas in a plasma state at column 6, lines 7-23.

George shows a UV lithography process and apparatus using a UV source gas (e.g., Ne for 85 nm, He for 65 nm, Ar for 130 nm, krypton (Kr) for 150 nm, xenon (Xe) for 170 nm, etc.) at column 3, lines 22-32.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the UV hardening exposure of a developed photoresist in an etching chamber that provides UV emission and etching using the hardened photoresist in the same chamber as taught by Sato and Tsai with Ar inert gas flow to the etching chamber during UV hardening at a flow rate of 10 to 10,000 sccm as taught by Singh (encompassing the Ar inert gas flow rate of about 1,000 to 3,000 sccm in instant claims 19-20) for more efficient cross-linking of the photoresist by the UV exposure as shown by Kishimura. It would also have been obvious to control inert gas pressure in the etching chamber during plasma post-treatment (UV exposure) of the developed photoresist image at 0.0001 to 1,000 Torr as shown by Singh (encompassing both the Ar inert gas pressure between about 50 to 300mT of instant claim 23 (unsupported by the instant specification as discussed above) as well as the unclaimed Ar inert gas pressure of about 1 to 5 Torr supported by instant page 16 of the original specification) to maintain the inert gas in a plasma state as described by Singh.

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the UV exposure hardening of developed photoresist and etching taught by Sato and Tsai with a UV generation source having Ne gas (instant claim 21) to obtain a 85 nm emission or a mixture of Ne and Ar (such as that obtained by a flow rate of Ne between about 0.2% and 0.8% of the flow rate of Ar, instant claim 22) to obtain an emission between 85 nm and 130 nm (UV light) as shown by George.

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato as applied to claim 16 above, and further in view of Rangarajan, et al. (US Patent 6,451,512).

Sato does not specify 5% to 75% conversion of the developed photoresist to a hardened layer before etching using the hardened layer.

Rangarajan teaches post-developing photoresist silylation in UV to enhance incorporation of silicon (Si) and cross-linking of the resulting organosilicon polymer in the photoresist for increased etching resistance (selectivity) at column 3, lines 14-26, column 4, line 66 to column 5, line 4, column 5, lines 14-42, 58-62, and column 7, lines 51-55. Column 6, lines 58-61 shows use of an inert gas (e.g., Ne, Ar, He, etc.) during the UV treatment. Si atoms are incorporated into the photoresist during UV hardening to a depth of between 2% and 100% of the photoresist thickness (column 10, lines 47-52).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to carry out the UV hardening of Sato and Tsai as discussed above in order to harden 2% to 100% of the developed photoresist layer (encompassing the 5% to 75% hardening of instant claim 24) to improve the etching resistance (selectivity) of the photoresist layer as shown by Rangarajan.

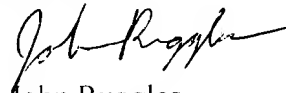
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*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 703-305-7035. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 703-308-2464. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.



John Ruggles  
Examiner  
Art Unit 1756



MARK F. HUFF  
SUPERVISORY PATENT EXAMINER  
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